

Claims

1. A process for the production of a sterol fatty acid ester-rich composition comprising the steps of:
  - (a) combining
    - 5 - a sterol composition, comprising one or more sterols,
    - a fatty acid glyceride composition, comprising fatty acid esters of one or more fatty acids, and
    - an esterification catalyst to form a reaction mixture,
  - (b) performing esterification of sterol(s) in said reaction mixture to produce a sterol fatty acid ester containing mixture,
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  - (c) adding a hydrolysis catalyst and an alkylating component to hydrolyse mono-, di- and/or triglycerides present therein and to produce corresponding fatty acid alkyl ester(s) and glycerol, and
  - (d) purifying the sterol fatty acid ester containing mixture to form a sterol fatty acid ester-rich composition.
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2. The process according to claim 1, wherein to the reaction mixture or to its components in step (a) is added at least one fatty acid alkyl ester.
3. The process according to claim 1 or 2, wherein step (d) includes step (d1) comprising purifying said sterol fatty acid ester containing mixture by removing
  - 20 glycerol from said mixture.
4. The process according to claim 3, wherein in step (d1) the esterification catalyst and/or the hydrolysis catalyst is removed together with glycerol from the sterol fatty acid ester containing mixture.
5. The process according to any one of claims 1 to 4, wherein step (d) includes step (d2) comprising purifying said sterol fatty acid ester containing mixture by separating fatty acid alkyl ester from said mixture.
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6. The process according to claim 5, comprising a further step of feeding fatty acid alkyl ester separated in step (d2) into the sterol composition, the fatty acid glyceride composition, the esterification catalyst and/or into the reaction mixture formed in step (a).
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7. The process according to any one of claims 1 to 6, wherein the hydrolysis catalyst and the alkylating component are added in step (c) as a pre-prepared hydrolysing and alkylating composition.
- 5 8. The process according to any one of claims 1 to 7, wherein the hydrolysis catalyst is KOH and the alkylating component is methanol, preferably being added as a pre-prepared methanolic KOH composition.
9. The process according to any one of claims 1 to 8, wherein in step (a) the esterification catalyst is chosen from the group comprising metal alkoxides, such as  $\text{NaOCH}_3$  and  $\text{NaOC}_2\text{H}_5$ , metal oxides, alkali hydroxides, metal soaps, metal  
10 alloys, metal hydrides, metal amides and their mixtures.
10. The process according to any one of claims 1 to 9, wherein the reaction mixture in step (c) comprises 0.01-10 % by weight, preferably 0.05-2 % by weight of the hydrolysis catalyst.
11. The process according to any one of claims 1 to 10, wherein the reaction  
15 mixture in step (c) comprises 0.01-75 % by weight, preferably 0.1-30 % by weight, most preferably 0.5-30 % by weight, of the alkylating component.
12. The process according to any one of claims 1 to 11, wherein the hydrolysing and alkylating composition or its separate components comprise at least 50 % methanol and at most 50 % KOH, preferably 65-99.5 %, more preferably 80-99 %, most preferably 85-95 % by weight of methanol and preferably 0.5-35 %, more  
20 preferably 1-20 %, most preferably 5-15 % by weight of KOH.
13. The process according to any one of claims 1 to 12, wherein step (d) includes the sterol fatty acid ester containing mixture being purified by bleaching, filtration and/or deodorisation.
- 25 14. The process according to any one of claims 1 to 13, wherein in step (a) the reaction mixture is formed by including in mol ratio 1 mol of one or more sterols, 0.3-0.7 mol of one or more fatty acid glycerides and 0.9-2.1 mol of one or more fatty acid methyl esters recycled from step (d2).
- 30 15. The process according to any one of claims 1 to 14, wherein the hydrolysis catalyst and the alkylating component are added to the sterol fatty acid ester containing mixture in step (c) when the esterification reactions are complete or mainly complete.

16. The process according to any one of claims 1 to 15, wherein the sterol fatty acid ester-rich composition produced comprises at least 90 %, preferably at least 94 %, more preferably at least 97 % by weight sterol fatty acid ester(s).
- 5 17. The use of a sterol fatty acid ester-rich composition produced by the process of any of claims 1 to 16 as a dietary, pharmaceutical and/or cosmetic product or in the preparation thereof.
18. A sterol fatty acid ester-rich composition produced by the process of any of claims 1 to 16.
- 10 19. A method for recovering food-grade sterol fatty acid ester(s) from a fat mixture containing fatty acid glycerides and sterol fatty acid ester(s), comprising the steps of:
- (i) adding to said fat mixture a hydrolysis catalyst and an alkylating component to hydrolyse the glycerides and to produce corresponding fatty acid alkyl ester(s), without significant hydrolysis of the sterol fatty acid ester(s),
- 15 (ii) removing excess alkylating component, the hydrolysis catalyst and glycerol,
- (iii) purifying the obtained product by washing with water and/or by an adsorbent treatment or by washing with an acid aqueous solution and/or by an adsorbent treatment, and
- (iv) purifying the obtained product by deodorisation to remove the fatty acid alkyl ester(s) and impurities and to produce pure sterol fatty acid ester(s).
- 20 20. The method according to claim 19, wherein the hydrolysis catalyst is chosen from the group of bases comprising alkali hydroxides, such as KOH and/or NaOH, and alkali oxides.
21. The method according to claim 19 or 20, wherein the alkylating component is chosen from the group of lower alcohols comprising C1-4 alkanols, preferably methanol and/or ethanol.
- 25 22. The method according to any one of claims 19 to 21, wherein the fat mixture, before adding the hydrolysis catalyst and the alkylating component, contains 1-99 %, preferably 30-97 %, and more preferably 70-95 % by weight glycerides and 1-99 %, preferably 3-70 %, and more preferably 5-30 % by weight sterol fatty acid ester(s).
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23. The method according to any one of claims 19 to 22, comprising adding to the fat mixture 0.01-10 %, preferably 0.05-2 %, by weight of the hydrolysis catalyst.
- 5 24. The method according to any one of claims 19 to 23, comprising adding to the fat mixture 0.01-75 %, preferably 0.1-30 %, more preferably 0.5-30 %, by weight of the alkylating component.
25. The method according to any of claims 19 to 24, comprising adding the hydrolysis catalyst and the alkylating component as a pre-prepared hydrolysing and alkylating composition.
- 10 26. The method according to any one of claims 19 to 25, wherein the hydrolysing and alkylating composition or its components include at least 50 % by weight methanol and at most 50 % by weight KOH, preferably 65-99.5 %, more preferably 80-99 %, most preferably 85-95 % by weight of methanol and preferably 0.5-35 %, more preferably 1-20 %, most preferably 5-15 % by weight of  
15 KOH.
27. The method according to any one of claims 19 to 26, wherein step (i) is carried out at a temperature between 60-100 °C, preferably between 60-80 °C, at a pressure of at most 100 kPa, preferably at most 7 kPa, and for a period of from 1 minute to 6 hours, preferably from 30 minutes to 2 hours.
- 20 28. The method according to any one of claims 19 to 27, wherein step (iv) is carried out at a temperature of between 160-230 °C, preferably 190-210 °C, and at a pressure of 1-1000 Pa, preferably 50-500 Pa.
29. Sterol fatty acid ester(s) produced by the method of any of claims 19 to 28.